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NOTES UPON SOME LOWER CALIFORNIAN HELICES.

BY HENRY A. PILSBRY.

The receipt of some *Helices* collected on Cerros (Cedros) Island, Lower California, by Mr. H. N. Lowe, has been made the occasion for giving plates illustrating the Micrariontas of Lower California and offering some notes upon the characters, variation, distribution, and type localities of the several forms. Information upon the habitats and stations of several species may be found in an article by Mr. Lowe in the *Nautilus* for July, 1913.

The only recent work of an exact nature upon these snails is in a paper published by Doctor W. H. Dall in *Proc. Acad. Nat. Sci. Phila.* for 1900, in which several new forms are defined. The fauna stands much in need of investigation by some one who can study the snails on the ground; who will look into the limits and characteristics of the snail colonies, locate them exactly, and *keep the snails of different colonies separate*. At present we have little knowledge of the association of forms or the range of variation within a colony.

The first *Helices* from the Lower Californian coast seem to have been collected by Dr. Hinds, who accompanied Capt. Belcher as surgeon of H. M. S. *Sulphur*. The *Sulphur* was engaged in work of survey and exploration along the West Coast in 1839, and opportunity for land collecting was had at San Diego and various points northward, San Quintin, Cerros Island, Turtle (San Bartolomé) Bay, and Magdalena Bay. Two species collected by Hinds were described by Pfeiffer in 1845, *Helix levis* and *H. areolata*, both reported, in the original descriptions, as from "California," whether Lower or Upper not specified; moreover, at the time of the *Sulphur* voyage the differentiation of the Californias seemed a small matter to Europeans, both being equally savage and remote.

During 1846 the *Herald* and *Pandora* surveyed parts of the coast—Victoria, Esquimalt Harbor, Port Discovery, Port Townsend, San Francisco Bay, San Nicolas, S. Clemente, San Diego Bay, Los Coronados, San Quintin, Cerros Island, Magdalena Bay.¹ A number

¹ *Narrative of the Voyage of H. M. S. Herald during the years 1845-'51*, by Berthold Seemann, 1853.

of West Coast shells were collected, but unfortunately the localities were badly mixed up, as in the *Sulphur* shells.

Good accounts of the explorations of Veatch, Gabb, Scammon, and others of that period together with much historical and other information concerning the peninsula may be found in a book issued by the Lower California Company, entitled, "Lower California: Its Geography and Characteristics," New York, 1868. The most extensive recent reports by scientific observers are those published by the California Academy of Sciences. These deal chiefly with the Cape region, which differs widely from the peninsula further north by reason of its far greater rainfall.

Helicoid and Bulimoid landsnails living in exposed places usually become more variegated than the related forms from sheltered or shaded places. When exposed to the sun, the ground color or the whole shell becomes opaque white, an adaptation to exclude light, which would shine through a brown, corneous, or yellowish shell, probably to the detriment of the snail. Compare *Cerion*, *Hemitrochus*, *Bulimulus schiedeanus*, *Leucochroa*, etc. Among snails living in dry, sunny places, there is also very often a tendency to multiply color-bands, in snails derived from stocks with one or few bands, as in *Euparypha*, *Hemitrochus*, *Plectostylus*, etc. This may possibly be protective, as a variegated shell is less conspicuous on a bush or weed than a one-colored shell.

The enhanced color development and variability of snails living on trees or other plants lead to the formation of color varieties from diverse variations in different colonies. Where the topographic and other environmental conditions favor isolation of colonies, permanent races or species result, as among the *Partulae* and *Achatinellæ*. When the colonies occasionally mingle by changing conditions of vegetation, etc., we have polymorphic hybrid races—colonies where great individual diversity of pattern or form are seen.

Lower California, exclusive of the Cape region, is probably an area of increasing aridity, like southern Arizona and Sonora, so that there is now a strong tendency towards restriction and consequent isolation of the snail colonies. The rather wide distribution of some of the species and the polymorphic coloration of many colonies leads us to believe that conditions formerly were much more favorable to migration and mingling of land snails. Subsidence has also played a part in isolating the snails of the small islands along the coast. That the changes have often been unfavorable is shown by the dwarfed size of many races, as on San Geronimo, Natividad, and Asuncion Islands.

The irregular apertural thickening, lumps, and uneven "teeth" of some forms of *M. levis* and others show the unfavorable action of extreme aridity.²

The apparent absence of Helicidæ on the comparatively well-watered southern end of the peninsula is an anomaly. I cannot help thinking that further search will bring some Helices to light. It is a region of fine Bulimuli.

In the northeastern part of the peninsula and on the Coronado Islands, *Micrarionta stearnsiana* Gabb is found.³ Farther down and inland the closely related *M. orcutti* Dall occurs. This seems to be constant in its divergence from *stearnsiana* in the large lot I have seen. Far off shore on Guadalupe Island is the small *M. guadalupiana* Dall, a perfectly distinct species of the typical group of *Micrarionta*.

On the sierra running down the peninsula near the eastern border there are several *Sonorella*-like species, such as *Helix lohrii* Gabb, unknown anatomically, but probably belonging to the desert group of *Micrarionta* characteristic of southwestern Arizona and southeastern California.

Micrarionta consists of three rather sharply differentiated groups or sections: (1) *Micrarionta* typical, small, compact shells with the lip strongly reflexed, insular in distribution, *M. ruficincta*, *gabbi*, *facta*, *guadalupiana*. (2) Section *Eremarionta* for *M. desertorum* P. & F., includes also *M. hutsoni* Clapp and probably all the Californian and Lower Californian species which have been referred to *Sonorella*. The lip is expanded, shell smooth. (3) Section *Xerarionta* for the capacious forms with the lip not expanded or but slightly so, the axis perforate or closed, the shell generally variegated, many-banded. *M. veatchii* may be taken as the type of this group, which extends from the Channel Islands of California to Magdalena Bay, on the islands and adjacent shore.

Micrarionta pandoræ (Forbes). Pl. XV, figs. 17 to 23.

Helix pandoræ Forbes, P. Z. S., 1850, p. 55, pl. 9, f. 3 a, b. Binney, Land and Fresh-water Shells of N. A. I, p. 179.

Epiphragmophora pandoræ (Forbes), Dall, Proc. A. N. S. Phila., 1900, p. 101.

Helix damascenus Gould, Proc. Boston Soc. N. H., VI, p. 11, 1856; Otia Conch, p. 219.

Epiphragmophora pandoræ bonitosensis Pils., Proc. A. N. S. Phila., 1898, p. 70, pl. 1, figs. 4, 5 (genitalia).

This species was collected by H. M. S. *Herald* or *Pandora*, the

² Cf. Dall, "On Insular Land Snail Faunas."

³ This has been shown by Mr. G. H. Clapp to differ specifically from *M. kelletti* of the Channel Islands.

locality uncertain. On p. 53 of Forbes' article, he states that "*Helix kelleltii* and *pandora*, both new, are probably from the same country [i.e., neighborhood of the Columbia River], though the box in which they were contained was marked Santa Barbara." On p. 55 he says, "collected near the Straits of Juan del Fuaco [Fuca]."⁴

The Santa Barbara Island Helix of this type is *tryoni* Newc. *H. pandora* must have come from some southern locality. Since specimens exactly resembling Forbes' figure were taken by Anthony and others on San Benito Island, off the north end of Cerros Island, that place may for the present be taken as the type locality, as no other place has yet afforded shells agreeing so well with Forbes' figures.

San Benito, or "Los Benitos," is west of the north end of Cerros Island and consists of two or three small and very barren islets. The name has also been spelled "San Bonito" (Captain C. M. Scammon).

Though we are considering Los Benitos the type locality of *H. pandora*, it must be said that we have no definite information of where the original lot was taken. The *Herald* touched Cerros Island, and left the *Pandora* behind to complete the survey. No further report of the movements of the *Pandora* is given in the narrative, but it is not unlikely that S. Benito was visited in the course of the survey. The fact that Forbes named the species for the *Pandora* may be taken, in the absence of any information to the contrary, as some indication that it was obtained by members of the *Pandora's* surveying party.

The locality "Santa Barbara, on Margarita Bay, Lower California, Forbes," quoted by Dall, I am unable to confirm, as I can find no place or bay so named on the coast of Lower California, on maps accessible to me.

Dall has noted that this small species "varies from white to dark gray above, and below may be white or banded with ashy-gray. The nucleus is, however, invariably of a livid purplish color, and the surface is dull and conspicuously striate." It is sometimes pure white (pl. XV, fig. 23), or has a few diffuse reddish-purple bands on the last whorl (pl. XV, figs. 21, 22), the apex whitish or dark (fig. 22 photographed abnormally dark).

The typical form (pl. XV, figs. 17, 18, 19, 20) is dull purplish above and banded below the periphery on a creamy ground, the apex purple

⁴ The Spanish Captain de Fuca has recently been canonized by a Californian conchologist, *Bull. S. Cal. Acad. Sci.*, X, p. 54, 1911.

or reddish. The lip is very slightly expanded, narrowly white-bordered within, and the columellar margin concave with no trace of a tooth. The embryonic whorl, when unworn, has radial wrinkles as in *veatchii*; the spire is not granular, and the last whorl shows spiral incised lines. Alt. 15, diam. 18 mm., $4\frac{3}{4}$ whorls. It was this form which I dissected, under the name of "*E. p. bonitosensis*."

M. pandoræ is anatomically similar to *veatchii* on a smaller scale. It belongs, I think, nearer *veatchii* than to any other species. As in other races of these small arid islands, *pandoræ* is conspicuously reduced in size, probably through the continuous influence of short active and long dormant periods.

The specimens figured are from S. Benito Island, collected by Anthony and Hemphill.

Micrarionta veatchii ('Newc.' Tryon). Plate XV, figs. 1 to 7 (varieties figs. 8 to 16).

Arionta veatchii [error for *veatchii*] Newcomb, Tryon, American Journal of Conchology, II, p. 316, pl. 22 (5), fig. 19, 1866. III, p. 162, 1867.

Helix veatchii Stearns, Proc. Cal. Acad. Sci., III, p. 328, 1867.

Helix areolata W. G. Binney, Land and Fresh-water Shells of N. A., I, p. 177, fig. 311, two figures in the middle.

A fine species, known by its large size, turbinate, elevated shape (which, however, is variable), and the coloration, somewhat like *Helix aspersa*, but also very variable; the embryonic shell when unworn is finely irregularly wrinkled radially. There is never any trace of a columellar tooth. It was described from Cerros Island, where Veatch collected it in 1859, and the typical form at least is confined to that place.

In specimens collected at the north end of Cerros Island by Mr. H. N. Lowe in 1912 (pl. XV, figs. 2, 3), the foot and sole are pale gray, back brownish-gray, paler towards the shell, near the edge yellowish-gray, under a lens seen to be closely peppered with yellow dots on a dark gray ground. A specimen of the same lot having the shell light colored (pl. XV, fig. 1) has the animal gray-brown throughout, a little darker on the back. The tail is depressed, back with the usual pair of grooves. In walking, the muscular waves extend entirely across the sole, and are about 5 mm. apart, more separated towards the tail. Foot about 60 mm. long. The shell in this lot (pl. XV, figs. 1, 2, 3) varies notably in degree of elevation and in color. The ground is pink-white; some shells are boldly marked with blackish-chocolate bands, as many as eleven in fig. 3. Others have the shoulder band well developed, several others weakly traced, fig. 2. In others, all the bands present are very weak, fig. 1; or again, the shoulder band alone is indicated by an interrupted dark fillet.

Granulation is weakly developed on the second and third whorls, and incised spiral lines are well developed on the last whorl.

The type lot of *veatchii* consists of smaller shells, pl. XV, figs. 6, 7, in which the bands number 9 or 10, are brown or blackish and more or less speckled. Fine, distinct granulation (as in *levis*) may be seen on the second and third whorls. The incised spirals of the last whorl are weak and much interrupted. The lip is slightly expanded, the callus within making it appear more expanded than it really is. This feature is rather poorly shown in the figures because of the darkness of the interiors in the photographs. In *M. levis* there is little or no expansion of the lip.

The largest individual seen measures, alt. $26\frac{1}{2}$, diam. $28\frac{1}{2}$ mm. It was collected by Hemphill (pl. XV, fig. 5). The highest in a series sent by Mr. H. N. Lowe measures, alt. $26\frac{1}{2}$, diam. $25\frac{1}{2}$ mm., with $6\frac{1}{2}$ whorls (fig. 2); and the lowest, in the same lot, is, alt. $24\frac{1}{2}$, diam. 28 mm., $5\frac{3}{4}$ whorls (fig. 1). The types were smaller, about 23 x 23 mm. Two of the type lot are figured, pl. XV, figs. 6, 7. In these the spiral incised lines are less developed than in the larger forms. The lip is less broadly expanded in many specimens, as in fig. 4, collected by Gabb.

Besides the typical elevated form already noticed, there are several more or less divergent forms found on Cerros Island. I have referred to these by number, as their status cannot be discussed intelligently until careful field work locates the colonies and gives material for a study of the variations in each.

(1) *M. veatchii leucanthea* Dall, from the eastern side of Cerros Island (pl. XV, fig. 10, a cotype, U. S. Nat. Mus. No. 107,627) is exactly like the lower forms of *veatchii* in shape of the shell and the rather broadly expanded lip. It differs by the absence of distinct bands on the pink-white surface and the more distinct granulation of the entire upper surface. The shell figured measures, alt. 23, diam. 26 mm., with $5\frac{1}{2}$ whorls.

(2) Shells collected on Cerros Island by Hemphill, what part of the island not stated, resemble *leucanthea* in shape and sculpture, but differ in having the lip expansion very narrow. In one lot (pl. XV, figs. 15, 16) the fleshy-brown bands vary from weak and "curdled" (like the traces of a band in *leucanthea*) to moderately strong.

(3) In another lot (pl. XV, figs. 13, 14) the last whorl has a pale brown tint; there are no bands whatever, but the surface is strewn with purplish-gray dots, translucent by transmitted light. The lip expands very narrowly.

(4) Natividad Island, off the south end of Cerros. A shell collected by Anthony and sent me alive by Dr. Dall (pl. XV, fig. 12) is banded and streaked profusely with purplish-brown. The embryo is distinctly wrinkled and the inner whorls following are somewhat granulated; lip narrow. Alt. 21, diam. 23.8 mm., with $5\frac{1}{2}$ whorls. The genitalia of this individual were figured by me as "*areolata*" in *Proc. A. N. S. Phila.*, 1898, pl. 1, figs. 6, 7. It certainly has nothing to do with the real *areolata*, but belongs to the *veatchii* group of forms.

(5) Turtle Bay, collected by Hemphill (pl. XV, fig. 9), white or pink-white, immaculate or with a few fleshy dots. Embryonic whorl wrinkled, the rest of the upper surface granulated more or less, lip very narrow. Resembles varieties (2) and (3), except in color.

(6) Turtle Bay, Hemphill (pl. XV, fig. 8). The white or pale embryonic whorl is nearly smooth (in 8 adult shells examined, no young ones seen); granulation appears weakly on the inner whorls, not on the last one or two. Lip expansion is narrow. The shell is compactly coiled. Bands speckled with white, either numerous, as in fig. 8, or reduced in number and intensity (as in fig. 15). Alt. 20, diam. 23 mm., with $5\frac{1}{2}$ whorls. This lot was sent out by Hemphill as "*H. areolata* var."

(7) Turtle Bay (pl. XV, fig. 11). Same as No. 6, but white with the coloring of *leucanthea*, plus some scattered fleshy dots.

Whether all of the Turtle Bay lots were from one colony or from several is not known. Mr. Hemphill sorted out his *Helices* into color forms, thereby destroying all evidence as to the composition of the colonies.

M. veatchii was named in honor of John A. Veatch, who surveyed Cerros Island in search of copper and other minerals in June, July, and August, 1859. By an error or oversight the name was spelled "veitchii" in the original account.

Micrarionta veatchii canescens (Adams and Reeve). Text fig. 1.

A series collected by Mr. H. N. Lowe at South Bay, Cerros Island, agrees well with the figures and description of *Helix canescens*,⁵

⁵ The original description follows:

"*Helix canescens*. Shell globose, nearly covered perforate, opaque white, ornamented with oblique streaks and several interrupted blackish concentric lines and a conspicuous central band, whorls 5, the last rotund-inflated. Aperture lunate-rotund, peristome thickened within, callous in the columellar margin. Hab. Africa. A white globose shell with simple lip banded and minutely sprinkled with black." (Adams and Reeve, in *Zoology of the Voyage of H. M. S. Samarang*, p. 62, pl. 16, fig. 10, 1848.)

which was described with the indefinite locality "Africa" and has not been recognized by subsequent authors, although Tryon has called attention to its resemblance to *veatchii*, etc. Part of the specimens (fig. 1, *a*, *b*, *c*) have a columellar tooth; some, as fig. 1, *b*, have the coloration of Adams and Reeve's type figure in the *Zoology of the Samarang*, pl. XVI, fig. 10. Others, fig. 1, *a*, have the pattern shown by Reeve in the *Conchologia Iconica*. Still other examples show but faint traces of dark markings, fig. 1, *c*. With these there were a few shells generally similar, but without the columellar tooth, fig. 1, *d*, which by themselves would be referred to *M. veatchii* var. No. 7, or with the tooth very weak, intergrading with the distinctly dentate form.



Fig. 1.—*Micrarionta v. canescens* (A. & R.), South Bay, Cerros Island.

The *Samarang* surveyed from Japan to Borneo, going and returning by the Cape route. They did not reach American shores, and touched Africa only at the Cape, where no such species as *H. canescens* is found. It seems to be one of several species without definite locality which Reeve inserted. Captain Belcher who commanded the *Samarang* had previously explored Cerros Island in the *Sulphur*, and probably he added *H. canescens* to the *Samarang* shells from his former collection.

By its columellar tooth *M. canescens* has affinity to *M. levis*. Whether it will eventually be united to *veatchii* or to *levis* remains to be decided, but it seems deserving of at least subspecific rank.

***Micrarionta levis* (Pfeiffer).** Pl. XVI, figs. 48 to 52, 42 to 45.

Helix levis Pfr., Zeitschrift für Malakozoologie, II, 1845, p. 152; Syst. Conchyl. Cabinet, p. 249, pl. 36, fig. 17, type, fig. 16, var.

Original description.—"Shell perforate, globose, thin, smooth, obliquely striate, obsolete granulate, whitish, variously ornamented with series of dots or pellucid corneous bands. Spire short, rather acute. Whorls 5, but slightly convex, the last inflated. Aperture rotund-lunar, colored like the outside or fulvous within; peristome

acute, somewhat labiate within, the columellar margin dilated above, vaultingly reflexed, nearly covering the perforation. Alt. 13, diam. 46 [typographical error for 16] mm. Variety: with a sharply defined, lengthened, tooth-like tubercle on the lower margin near the columella (fig. 16)."

Pfeiffer's figure of the type, pl. XVI, fig. 51, and of the variety pl. XVI, fig. 52, are copied photographically.

This is a rather small species (diam. 17 to 20 mm.), compactly coiled, rather solid though generally somewhat thin, opaque white or very light brown, encircled with many blackish lines and narrow bands, which are more or less interrupted or speckled with white. The embryonic whorl is usually brown, rarely whitish. The surface of several post-embryonic whorls is minutely *granulated*. The last whorl is not distinctly striated spirally. Lip hardly expanded, narrowly thickened within, at the columella it is dilated, and white-calloused within, the callus often ending abruptly below, or in form of a small tooth. Whorls 5 in small, up to $5\frac{1}{2}$ in large individuals.

Specimens in the Academy are from San Rosario (Orcutt!); San Geronimo Island, fossil only (H. N. Lowe!); Lagoon Heads, Cerros Island, and Turtle Bay (H. Hemphill!); Asuncion Island, fossil only (Stearns). Also reported by Dall from Rosalia Bay, between the second and third localities above.

Pfeiffer records that this species was taken by Hinds in "California." Hinds, on H. M. S. *Sulphur*, Capt. Belcher, visited California and Lower California, stopping October 28, 1839, at Turtle Bay, which is another name for S. Bartolomé Bay, or Port, a good harbor a short distance below the projection of the peninsula below Cerros Island. As Hemphill found the species here in some abundance, I propose to select Port San Bartolomé as the type locality. The *Sulphur* landed a party at this place to make observations for position. The geological features and marine shells are mentioned in Captain Beechey's narrative (Vol. I, p. 330), and I think it almost certain that Hinds, who was a good collector and conchologist, picked up the *Helix levis* here.

Small specimens, such as pl. XVI, fig. 45, and others of the same lot agree perfectly with Pfeiffer's description and his type figure. Others from Turtle Bay, such as figs. 42, 43, are larger, more elaborately decorated, and show more of a columellar tooth.

Shells from San Rosario, Cerros Island (fig. 44), and Lagoon Heads are practically identical with those from Turtle Bay. All of these places except Cerros Island are on the mainland. Other localities

have varying forms, which for the present I have designated by numbers, as follows:

(1) Asuncion Island, not far below Turtle Bay, has a somewhat differing race (pl. XVI, fig. 48). The bands, translucent instead of brown, are usually fewer and broader—five or six, or sometimes as many as ten. Granulation indistinct or obsolete. Diam. 16 to 19 mm. All the specimens seen from this tiny, barren islet were dug out of fine sand. It probably occurs only fossil. It is much like Pfeiffer's figures of *levis*, but the granulation is scarcely visible.

(2) Var. *crassula* Dall (pl. XV, fig. 24) from Natividad Island (south of Cerros) is like the preceding in having few translucent bands, about 6 in the cotype figured. It is somewhat heavier than *levis* of equal size, and is a little more elevated. No granulation is now visible on the corroded surface. The columellar callus is heavy and prominent. Alt. 15, diam. 17 mm., with nearly $5\frac{1}{2}$ whorls (*levis* of the same diameter has $\frac{3}{4}$ of a whorl less). Fossil.

(3) The variety from San Geronimo Island (pl. XVI, figs. 49, 50, coll. by H. N. Lowe) resembles *crassula* in contour and banding. It is not quite so heavy, has a half whorl less, and is well enough preserved to show traces of granulation on the spire in some examples. It was found fossil. Specimens measure:

Alt. $14\frac{1}{2}$,	diam. $16\frac{1}{2}$ mm.;	5 whorls.
" 14 ,	" $15\frac{1}{2}$ "	5 "
" 14 ,	" 14.8 "	5 "
"	" 18 "	(broken).

It appears that on these small, barren islets the *levis* stock has deteriorated in size, often becoming more globose, and finally has died out. The weak sculpture and usually small number of bands (in comparison with Turtle Bay *levis*) are probably ancestral characters preserved in these isolated colonies. So far as I know, these diminished races are extinct. The bands of these helices, brown or blackish in life, become translucent gray in long dead or fossil specimens.

(4) *M. levis globosa* n. subsp. Pl. XVI, figs. 46, 47. The shell is globose-conic, higher than *levis*, with *very little* of the granulation of that species, solid, glossy, multilinate with brown on a white ground, or sometimes bluish-white without bands. *Columella strongly toothed*. Alt. 20.3, diam. 22.3 mm., $5\frac{1}{3}$ whorls; or higher, alt. and diam. 22 mm. Cerros Island, living. Probably Binney's two outside figures 311, in Land and Fresh-water Shells, I, p. 177, represent this race.

Micrarionta areolata ('Sowb.' Pfr.). Pl. XVI, figs. 25 to 33.

Helix areolata Sowb. ms., Pfr. Zeitschr. f. Malak., II, p. 154, 1845; in Philippi, Abbildungen, etc., II, p. 184, pl. 9, f. 4; Conchylien Cabinet, p. 248, pl. 36, f. 10-13. Crosse and Fischer, Miss. Sci. Mex., Moll., p. 262, pl. 11, f. 4.

Epiphragmophora areolata (Sowerby) Dall, Proc. A. N. S. Phila., 1900, p. 100.

Helix areolata was described by Pfeiffer from specimens brought home by Hinds, with no more informing locality than "California." In a later publication he adds "on the Columbia River in California." Several places visited by Hinds on the *Sulphur* along the coast allow a wide range of choice for the type locality: San Quintin Bay, Cerros Island (where no shells seem to have been collected by Hinds), Turtle (Bartolomé) Bay, and Magdalena Bay, where several days were spent.

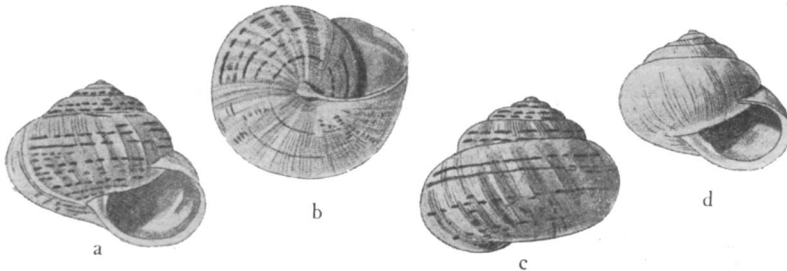


Fig. 2.—a, b, c, type of *Helix areolata*; d, *H. areolata*, variety. Copied photographically from the *Conchylien Cabinet*.

Pfeiffer described it as having the columella unidentate,⁶ diam. maj. 26, min. 23, alt. 18 mm.⁷

The specimen measured, presumably considered the type, was figured by Philippi (Abbildungen, etc.) and again in the Conchylien Cabinet, pl. XXXVI, figs. 10-12. These figures are copied photographically in text-figure 2 a, b, c.

Reeve and Crosse have figured specimens of the tessellated Magdalena Bay form, and some in the Academy Museum, received from Sowerby many years ago (pl. XVI, fig. 4) are of the same rather depressed race, and agree well with Pfeiffer's figures, though neither

⁶ Pfeiffer later qualified this by the expression "*plerumque unidentato*," and in the Conchylien Cabinet he says the columella of the type is "*undeutlich einzahnig*," and recognizes two varieties: "Variety 1. Smaller, more globose; umbilical perforation almost closed; columellar tooth distinct and strong, fig. 13. Variety 2. With the columellar tooth entirely wanting."

⁷ Pfeiffer measured the altitude of *Helices* along a line parallel to the axis of the shell, and not to the base of the lip, as is now done. By the modern system it would be 22 mm. high.

of them is fully mature. I think, therefore, that "Magdalena Bay" should undoubtedly be taken as the type locality of *H. areolata*. Further information is needed to determine the exact place in that neighborhood where shells agreeing with Pfeiffer's figures 10-12 (my text-fig. 2) are found, whether on the mainland or on Margarita Island. None of the shells before me are exactly localized. They bear the general locality "Magdalena Bay." It is evident from the five lots seen that different colonies vary in size, elevation, and degree of maculation.⁸ Pfeiffer's type and the specimens received from Sowerby are more depressed than most other lots.

The more northern localities cited for *areolata* by Dr. Cooper and others pertain, I believe, to forms of the *levis* group, which is known to occur from Asuncion Island northward, a region where *areolata* does not occur. The known areas of *levis* and *areolata* are separated by a long reach of coast whence no land snails are known. The Natividad Island specimen I dissected as *areolata* (1898) is a form of *veatchii*. With the exception of var. *exanimata* Cooper, *areolata* is not known to occur elsewhere than about Magdalena Bay, where it inhabits one of the driest regions in the world.

The shell is opaque white, with ochre-brown bands broken into square spots, very variable in number and arrangement, as shown in the figures. In one lot, markings are absent, or indistinct and corneous. The embryonic whorl is grayish corneous or yellowish corneous. The columella varies from simple to distinctly toothed. The size varies.

Alt. 21 , diam. 25 mm.; $5\frac{1}{3}$ whorls.
 " 18 , " 23.3 "
 " 16.3, " 19 " $4\frac{3}{4}$ "

(1) Var. *arida* (pl. XVI, figs. 39, 40, 41). Small, thin, white, or having sparse markings of typical form and color; lip hardly or not thickened, columella concave, not toothed. Descent of the last whorl to the aperture deeper and longer than in any other form of *areolata*.

Alt. 14, diam. 18 mm.; $4\frac{1}{2}$ whorls.
 " 15, " $18\frac{1}{2}$ " $4\frac{2}{3}$ "
 " 13, " 17 "

Magdalena Bay (R. C. Macgregor).

⁸ The locality "Margarita Bay, Newcomb," quoted by Dall, must have been an error or slip of Newcomb's for Magdalena Bay, or more likely Margarita Island, which guards the bay, since, so far as I can learn, there is no Margarita Bay on that coast.

(2) Var. *scammoni* (pl. XVI, figs. 34, 35, 36). Small, with many or few narrow brown bands (translucent gray in fossil or dead shells), continuous or nearly so, sometimes wanting. Columellar tooth usually developed, often weak, sometimes wanting.

Alt. 15,	diam. 20.3 mm.;	whorls $4\frac{3}{4}$.
" 17.8,	" 22 "	" $4\frac{3}{4}$.
" 17,	" 20.5 "	" $5\frac{1}{3}$.

Magdalena Bay (W. M. Gabb), 14 specimens.

Pfeiffer's fig. 13 (copied in my text-fig. 2, *d*) was probably this variety, which I name for Capt. Scammon, who has given a good account of this coast.

(3) Var. *aspera* (pl. XVI, figs. 37, 38). Small, last whorl *globose*, spire short. With wide marbled brown bands resembling those of *M. veatchii* or *Helix aspersa* in pattern. Columellar tooth distinct or indicated.

Alt. 17.3,	diam. 20 mm.;	$4\frac{3}{4}$ whorls.
" 14.8,	" 17 "	

Magdalena Bay (W. M. Gabb).

(4) Var. *exanimata* Cooper, *Proc. Col. Acad. Sci.* (2) III, p. 216, pl. XIV, fig. 7, from Espirito Santo Island, in the Gulf of California, is known to me only by the original account. I would expect it to be specifically different. It is the only form of this group yet found on the gulf side of the peninsula.

Helix decorata Pfr. (Conchyl. Cab., p. 249, pl. XXXVI, figs. 14, 15), the locality of which is unknown, may be a fully colored, thin, depressed form of *areolata*. It has been referred to *H. pisana* with doubt, and seems to be a "lost species." It is not *Helix decorata* Fér. I have copied the figures of *decorata* in text-fig. 3.



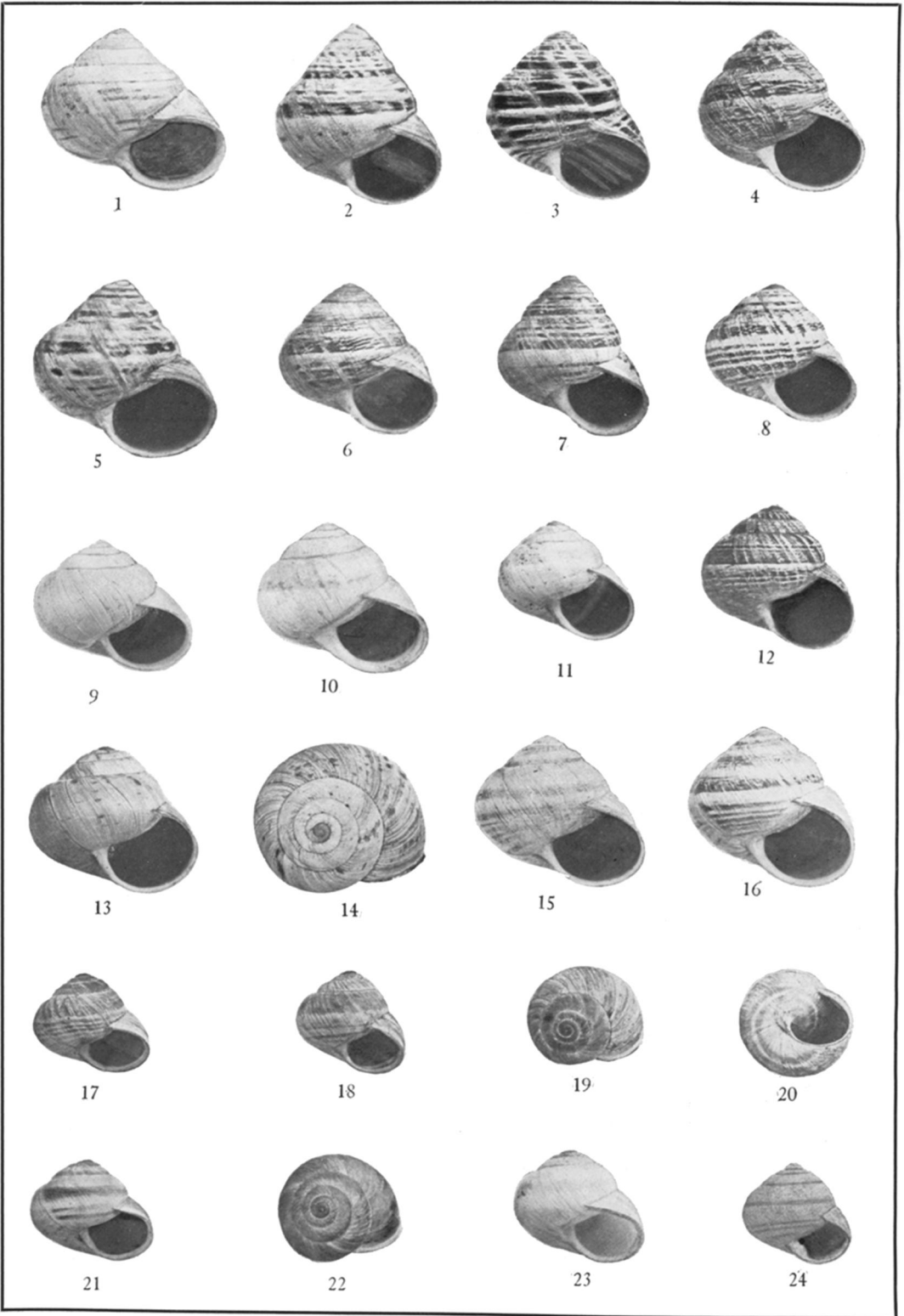
Fig. 3.—*Helix decorata* Pfr., copied from the *Conchylien Cabinet*.

EXPLANATION OF PLATES XV, XVI.

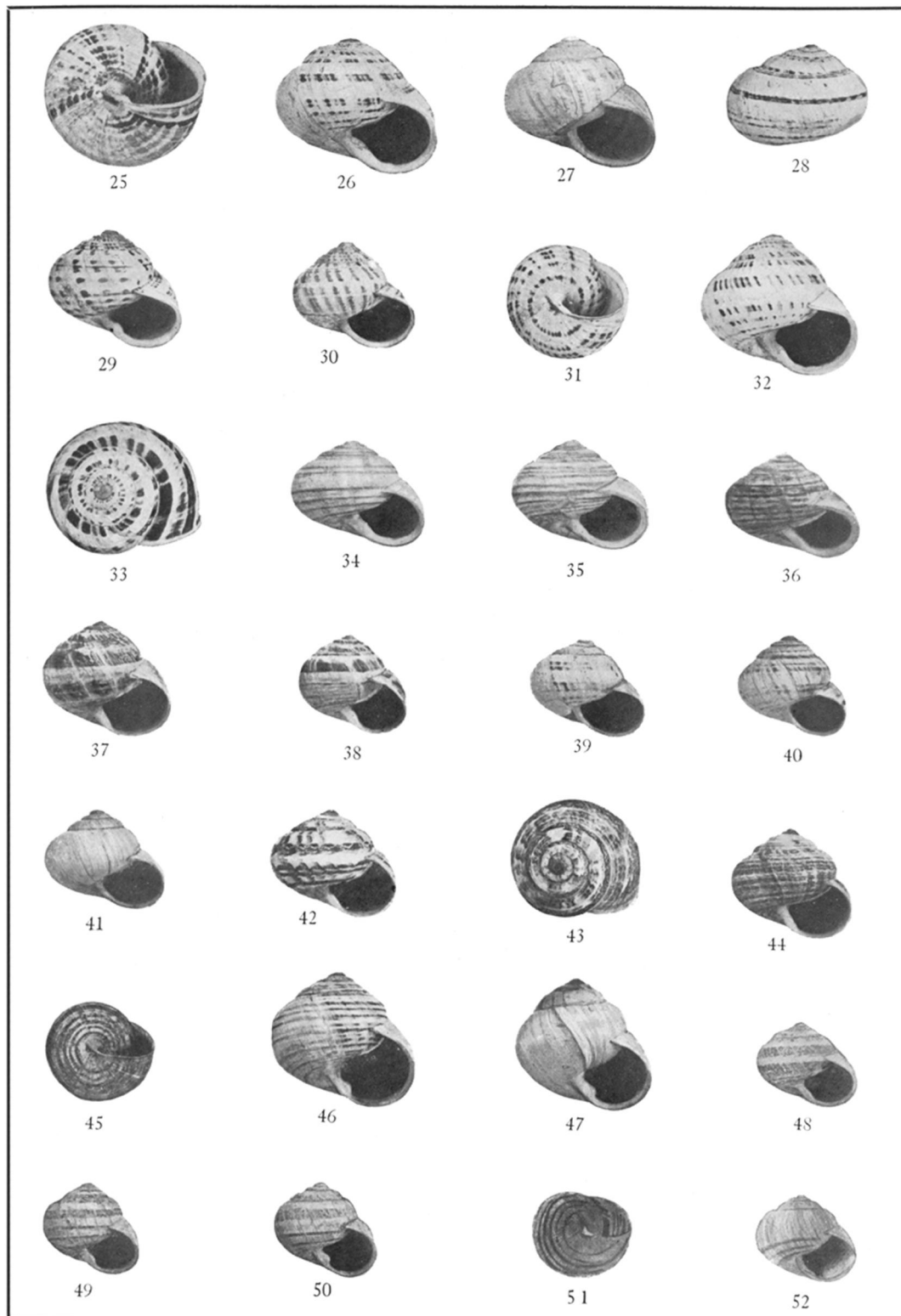
PLATE XV.—Figs. 1, 2, 3.—*Micrarionta veatchii* 'Nc.' Tryon. North end of Cerros Island. H. N. Lowe. A. N. S. P. No. 106,016.
 Fig. 4.—*M. veatchii*. Cerros I. Gabb. No. 10,261.
 Fig. 5.—*M. veatchii*. Cerros I. Hemphill. No. 60,034.

- Figs. 6, 7.—*M. veatchii*. Cerros I. Newcomb. Two of the cotypes. No. 10,263.
 Fig. 8.—*M. veatchii*, var. 6. Turtle Bay. Hemphill. No. 60,038.
 Fig. 9.—*Micrarionta veatchii*, var. 5. Turtle Bay. Hemphill. No. 60,046.
 Fig. 10.—*Micrarionta veatchii*, var. *leucanthea* Dall. Cotype, U. S. Nat. Mus. No. 107,627.
 Fig. 11.—*Micrarionta veatchii*, var. 5. Turtle Bay. Hemphill. No. 60,041.
 Fig. 12.—*Micrarionta veatchii*, var. 4. Natividad Island. Anthony. No. 69,646.
 Figs. 13, 14.—*Micrarionta veatchii*, var. 3. Cerros Island. Hemphill. No. 60,036.
 Figs. 15, 16.—*Micrarionta veatchii*, var. 2. Cerros Island. Hemphill. No. 60,035.
 Figs. 17–20.—*Micrarionta pandoræ* Forbes. S. Benito Island. Anthony. No. 66,092.
 Figs. 21, 22, 23.—*Micrarionta pandoræ*, Forbes. S. Benito Island. Hemphill. No. 10,297.
 Fig. 24.—*Micrarionta areolata crassula*, Dall. Cotype Natividad Island. Anthony. U. S. Nat. Mus. No. 107,623.

- PLATE XVI.—Figs. 25, 26.—*Micrarionta areolata* 'Sowb.' Pfr. Magdalena Bay. Hemphill. A. N. S. No. 10,298.
 Fig. 27.—*M. areolata*. White form. No. 10,299.
 Fig. 28.—*M. areolata*. Specimen received from Sowerby. No. 10,300.
 Figs. 29, 30, 31.—*M. areolata*. Magdalena Bay. W. M. Gabb. No. 10,264.
 Figs. 32, 33.—*M. areolata*. Santa Maria Bay. Stearns. No. 10,301.
 Figs. 34, 35.—*M. areolata scammoni* Pils. Cotypes. Magdalena Bay. Gabb. No. 10,302.
 Fig. 36.—*M. areolata scammoni* Pils. Cotype. No. 10,266.
 Fig. 37, 38.—*M. areolata aspersa* Pils. Cotypes. No. 10,265.
 Figs. 39, 40, 41.—*M. areolata arida* Pils. Cotypes. No. 76,208.
 Figs. 42, 43, 45.—*M. levis* Pfr. Turtle Bay. Nos. 60,045, 60,042.
 Fig. 44.—*M. levis* Pfr. Cerros Island. Hemphill. No. 60,037.
 Fig. 46.—*M. levis globosa* Pils. Type. W. M. Gabb. No. 10,304.
 Fig. 47.—*M. levis globosa* Pils. No. 10,305.
 Fig. 48.—*Micrarionta levis* var. Asuncion Island. R. E. C. Stearns. No. 10,306.
 Figs. 49, 50.—*Micrarionta levis* var. 1. San Geronimo Island. H. N. Lowe. No. 109,064.
 Fig. 51.—*Micrarionta levis* Pfr. Photographic copy of Pfeiffer's type figure.
 Fig. 52.—*Micrarionta levis* var. Photographic copy of Pfeiffer's figure.



PILSBRY: LOWER CALIFORNIAN HELICES.



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